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# Hydrodemolition and Use of a Rapid Early Strength Latex Modified Concrete Overlay

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## **TECHNICAL ASSISTANCE REPORT**

### **Hydrodemolition and Use of a Rapid Early Strength Latex Modified Concrete Overlay**

KTC-TA-15-01/KHIT6-15-1F

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**Sponsoring Agency:**  
Kentucky Transportation Cabinet

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April 2015

# **Hydrodemolition and Use of a Rapid Early Strength Latex Modified Concrete Overlay**

## **INTRODUCTION**

On July 11, 2014, KYTC held a letting for the hydro demolition of two bridge decks on I-64 in Franklin County - main-line twin bridges over Cardwell Lane MP 51.516 (Contract ID 143915; Fed/State Project No. IM 0643(052)). The special notes for the project are provided in Appendix A. The tabulation of bids is provided in Appendix B. Five bids were received ranging from \$787,836.00 to \$1,082,639.46. The contract was awarded to the lowest bidder, Halls Contracting. Each bridge is 30 ft. wide and 159 ft. long, with for a total area of 4,770 ft<sup>2</sup>. The type 104 bridges have a 14° skew and consist of three 59-ft. spans. The engineer's estimate for the total amount of latex modified concrete (LMC) overlay material needed on both bridges was 58.8 yd.<sup>3</sup>. Each of the bridges has two 13 ft.-wide lanes and two 2 ft. curbs. Recent bridge traffic data showed the bridges have ADT and ADTT values of 25,569 and 11,487, respectively. These values applied to each structure. The overlay depths were to be nominally 2 in. At the bridge ends the overlay depth was to be increased to 3 in. to accommodate new bridge seals. The overlays were to be placed on individual lanes during four overnight single-lane closures. For each lane, the removal of the existing concrete overlay and placement of a new overlay was to be completed in one night with the lane re-opening in the morning.

To facilitate that ambitious schedule, the contractor was to remove deteriorated deck overlay by milling/hydrodemolition along with the placement of a high-early-strength LMC overlay to allow the lanes to be placed back under traffic in a minimum time interval. After hydroblasting, chain dragging was to be used to find any remaining damaged (delaminated) areas for removal by manual jackhammering.

The high-early-strength LMC used CTS Rapid Set<sup>®</sup> Cement, which is on the Cabinet's Kentucky Product Evaluation List (KPEL). That material provides an initial set in 15 min. and a final set in 35 min. When tested to ASTM C109 (Modified) Compressive Strength of Mortars it provided a 3-hour compressive strength of 5,000 psi. KYTC personnel were to cast standard 6 in. compression cylinders of the latex modified concrete at the jobsite and perform breaks beginning 2 hours after the pour from the second LMC truck. The breaks were to be suspended when the desired LMC compression strength of 3,000 psi was obtained. Those tests were to be performed at the KYTC Division of Materials laboratory.

KTC researchers were assigned to monitor the project under Kentucky Highway Investigative Task No. 2015-6 "Hydrodemolition and Use of a Rapid Early Strength Latex Modified Concrete Overlay on The Decks of the I-64 Twin Bridges over Cardwell Lane in Franklin County." KTC researchers performed a preliminary site inspection on August 28, 2014 and found the bridge decks to be in poor condition (Figures 1, 2). The riding surfaces of both decks exhibited extensive spalling and transverse cracking. Many spalled areas had been patched with cementitious patching compounds and/or asphalt. Some of the patches had either failed or were failing and, at one patch location, exposed reinforcing steel was present (Figures 3, 4). A significant amount of repairs had been made to the substructure concrete (Figure 5). The undersides of the decks showed signs of efflorescence, cracking, spalling and exposed corroding reinforcing steel. Those observations indicated that, at many locations, the distress extended

down through the deck including the lower reinforcing mats and bottom concrete cover (Figures 6, 7). A diagram of the bridge deck riding surface condition prior to work is shown in Appendix C.

The hydrodemolition equipment was provided by The Hughes Group. Their specialized equipment uses a lower blast pressure than typically employed by other manufacturers' equipment. This is advantageous as there is less likelihood of the water blasting a "punch through" that penetrates the entire depth of the deck.

A Hughes representative described their hydrodemolition unit as follows, *"Our hydrodemolition robots utilize a direct impact, oscillating cutting head. All water is fed to the robot from our pump unit at a constant flow rate of 55 gal/minute minimum and at a constant pressure which will range between 12,000 psi and 20,000 psi. These are the optimum pressure ranges for complete selective removal of deteriorated concrete in a bridge deck. The flow rate and pressure are adjusted based on what is specified for the job removal limits and the condition of the bridge deck. A calibration of the equipment is performed per the Kentucky Specifications to determine the optimum flow rate and pressure rate required plus the optimum transverse speed of the water jet and the step of the robot. A high pressure hose 3/4" diameter connects the pump unit to the hydrodemolition robot. At the robot, the high pressure hose connects to the direct impact, oscillating cutting head located on the robot. From there the water enters the cutting head and then exits through a 1/4" orifice which is located approximately 2" from the deck surface and directly impacts the bridge deck surface. The cutting head oscillates back and forth 6" in the direct of travel of the robot. The robot steps 3" at a time - each time the cutting head travels across the 8' width of the robot. This means every area of the deck gets hits 2 times by the water jet to insure complete selective removal of 100% of the deteriorated deck concrete and to provide a highly rough & bondable surface for the new LMC overlay. Note - the cutting head is angled at 20 degrees to the deck surface which means the water jet directly impacts the deck at a 20 degree angle in both directs of travel. This insures that deteriorated concrete is removed from under reinforcing steels if present (1)."*

The Hughes representatives claimed their unit is very effective at removing the distressed concrete down to (and below) the upper reinforcing mat. The equipment can be adjusted to achieve more or less penetration into the concrete. For this project, the blasting equipment was set to run at 14,000 psi water pressure with a flowrate of 78 gpm. On the WB Bridge the nozzle cycle time was set at 5 to 7 seconds. To reduce the possibility of excessive "punch throughs" the cycle time was reduced to 3 to 4 seconds on the EB Bridge.

Work began on September 09, 2014 at 7:00 pm in the left lane of the WB Bridge. Before work started, the drains were dammed to prevent entry by wastewater. The first step was to mill the deck concrete close to the level of the reinforcing steel (1.5 in.). This was performed using a standard pavement rotary milling machine and took one hour to complete. The milling process cut several reinforcing steel bars. Those were saw-cut and removed (Figures 8, 9). The perimeter of the work was delineated by a 3/4 in.-deep cut made with a pavement saw to create a straight border (Figure 10). The hydroblasting equipment was moved into place and set up for the automated step process of moving the nozzle side to side then rolling the unit forward (Figure



11). The hydroblasting took 3 hours to completely treat the deck. To cover the 15-ft. swath it was necessary to hydroblast one-half the width of the deck with the hydroblast unit's 8-ft. sweep. Then it was reset at its starting point, but moved laterally to cover the adjacent untreated portion of deck. Using this procedure, the hydroblast unit was able to treat the entire section of deck in one pass. In the left WB lane, there were no "punch throughs" though there was exposed upper mat reinforcing steel throughout the length of the hydroblasting operation. The Hughes Company used a vacuum truck that sprayed water to clean the deck. Its vacuum removed the loose rubble and water left behind from the deck preparation work (Figure 12).

An inspector subsequently tested the remaining concrete for delaminations using a chain drag (13). After that operation, the contractor removed any unsound concrete by jackhammering (Figure 14). The vacuum truck also collected the debris resulting from this process. Remaining sound concrete cover over the upper reinforcing mat was not removed (Figure 15). Throughout the treated deck, there was remaining concrete cover over the upper reinforcing mat. Those locations were primarily areas that had been patched previously.

To prevent contamination of the prepared surface before placing the overlay, the crew used plastic to cover it where the concrete trucks would be present (Figure 16). Paving of the new overlay started at 5:15 am on September 10 and was completed by 6:30 am (Figure 17). Concrete samples were taken directly from the LMC truck to test for air and temperature. The high-early-strength LMC had a temperature of 85° F and air entrainment of 7% - 8%. 21.9 yd<sup>3</sup> of high-early-strength LMC were used on this lane. The concrete trucks mixed the wet and dry components before they were discharged from the truck. The operator adjusted the LMC mixture until it was correct. This determination was based on visual assessments conducted by both the operator and the workers placing the LMC (Figure 18). The contractor used a Bidwell paving machine to set the proper deck height and slope and completed the pour without issue (Figure 19). The rails were set to provide a finished overlay height that matched that of the adjacent deck surface, which was not replaced that night. Once the overlay was placed, a worker applied the surface texture by tining (Figure 20). Wet burlap and plastic sheeting were placed on the overlay during curing.

After four hours of cure the concrete cylinders taken at the beginning of the pour were tested for compressive strength and broke at 4,227 psi. Traffic was allowed back on the lane after the cylinder break provided the proper concrete strength.

On September 14, 2014 at 7:00 pm, the contractor started milling work on the WB right lane. The initial milling depth was set to remove 1.5 inches of concrete cover. For a second time, the milling operation cut reinforcing steel – this time at 20 different locations. Hydroblasting commenced at 8:00 pm.

Hydroblasting resulted in a "punch-through" hole approximately 3 in. x 5 in. close to the east abutment (Figure 21). The hole expanded as workers used jackhammers to remove the

unsound concrete. After the jackhammering, the hole measured approximately 3 ft. x 5 ft. (Figure 22). The crew placed extra reinforcing steel in the void area to provide extra support for the existing reinforcing steel. They placed a plywood sheet on the bottom side of the deck to allow for casting a partial deck repair.

USG Duracal® was used to patch the hole. At 3:20 am, the Duracal® was mixed with sand and small gravel shoveled from piles into the scoop of a front-end loader. The exact amount was not measured. The manufacturer suggests using 50 lbs. of both coarse and fine aggregate with every 50 lb. bag of Duracal®. The contractor's workers added water to mix using an unmeasured water hose (Figure 23). The Duracal® manufacturer suggests that 1.75 gal of water be used per 50lb. bag of its cement when small gravel and sand are used in the mix. No sampling/testing of the patching compound was performed before or after it was placed. KTC researchers thought the mixed patch material appeared excessively wet. The patching compound was poured in to the "punch through" with no consolidation. It was poured to just below the upper reinforcing steel level (Figure 24). Duracal® data sheet states 3,200 psi break strength at a two hours cure time. At 4:20 am the overlay was applied using the same process as with the previous lane. The latex modified concrete had an air entrainment of 4.3 %, and its temperature was 70° F. At 6:15 am, the LMC application was completed and after about four hours the cylinders broke at 3,500 psi. The road reopened to traffic at 10:15 am. This application used 22 yd<sup>3</sup> of LMC overlay material.

On September 17, 2014 at 7:00 pm milling work started in the left lane of the EB Bridge. The contractor changed the milling depth to prevent cutting as much reinforcing steel as occurred on the WB bridge. The milling depth was set to 0.5 in. No reinforcing steel was cut. Milling was completed at 8:00 pm and the hydroblasting operation began at 10:11 pm. A pump feeding the hydroblast unit stopped several times due to inadequate water supply. The hydroblasting punched another hole through the deck in the second span. After removing the unsound concrete, it measured approximately 4 ft. x 5 ft. (Figure 25). At 11:15 pm hydroblasting finished. At 11:30 pm, chain dragging revealed many unsound concrete spots (i.e. delaminations). Jackhammering was completed at 2:00 am. Using Duracal®, the patch to seal the "punch through" was completed in the same way as the first. The LMC pour started at 3:20 am and was finished at 4:51 am with no problems. Air entrainment was measured at 4.2% and the temperature 72° F, with 17.13 yd<sup>3</sup> of LMC overlay material used. The cylinders broke at four hours with a compressive strength of 3,615 psi. This was sufficient to allow traffic back on the bridge.

On September 18, 2014 at 6:50 pm milling work began on the last lane being overlain, the right lane of the EB bridge. The contractor again used shallow milling depth of 0.5 in. Despite the shallow milling, reinforcing steel was cut in several different locations. Workers saw-cut the damaged reinforcing steel and removed it. Hydroblasting began at 8:15 pm. For the second time on the WB bridge, the contractor experienced a problem with supplying sufficient water to the hydroblasting machine. At 10:15 pm the hydroblasting was completed and the vacuum truck removed the concrete debris. Chain dragging was performed on the deck while the

vacuum truck finished cleaning. The workers found several spots in need of jackhammering, but this lane had no “punch throughs.” The overlay placement began at 3:00 pm. The high-early-strength LMC had 3.9% air entrainment, and its temperature was 73° F. No problems were encountered during the overlay placement, and it was completed at 4:35 pm. For this phase of work 24.41 yd<sup>3</sup> of high-early-strength LMC were used. Excess water was observed pooling on the concrete behind the concrete truck discharge chute (Figure 26). The cylinders were broke four hours after the LMC had been sampled (from the second mixing truck) at a strength of 3,362 psi. Shortly thereafter, the lane was opened to traffic.

The completed deck overlays have been in service about 7 months. No signs of problems have been observed (Figures 27, 28).

## **CONCLUSIONS**

The repair method used for this project was largely successful. The amount of LMC placed was 86.3 yd<sup>3</sup> compared to 58.8 yd<sup>3</sup> in the engineer’s estimate. One major concern was the poor initial condition of the decks on both bridges. That presents a major obstacle to the durability of this project. Use of the pavement milling machine posed some problems due the variable depth of the upper reinforcing mat in the deck, which led to loss of reinforcing steel in three of the four lanes (though those losses may not have been substantial). The hydrodemolition equipment deployed at these locations removed most of the distressed concrete, but did not prevent “punch throughs” in two of the lanes (even after the hydroblast unit’s nozzle cycle time was decreased from 5-7 to 3-4 seconds). On all four lanes, chain dragging performed after hydroblasting revealed locations that still required jackhammering after the hydroblasting. The concrete patching material used to fill the “punch throughs” is commonly used on bridge decks. Better control and oversight were probably warranted for both the mix proportioning and the addition of water. According to the Duracal® data sheet a two-hour cure time would allow for proper strength of 3,200 psi. Each patch cured for more than two hours before traffic was let back on the bridges. Appendix C contains a diagram that shows the locations of the two patches.

The high-early-strength LMC was at/above the specified strength when the lanes were reopened, but in those patch locations it would have been good to see some break strengths of the Duracal® in the “as mixed” condition. The high-early-strength LMC went down well and provided the specified strength required to permit opening of the deck sections to traffic in a short time period after the overlay placement. What will be of interest is the durability of the deck repair, especially in light of the poor initial conditions of the decks and the rapid repair method/materials employed.

## **RECOMMENDATIONS**

1. This approach to deck repair appears to be viable. It would be beneficial to apply it on bridge decks in better initial condition and compare the durability of the two projects.
2. If rotary pavement milling equipment is used to remove most of the concrete cover from the deck, the potential for reinforcing steel damage is high due to variances in deck cover. Additional reinforcing steel and splices should be used to repair all damage sites.
3. The hydroblasting equipment worked satisfactorily. Comparisons of this hydroblasting equipment and more conventional units should be performed to assess the different outcomes of decks treated using the different types of equipment.
4. Contractors should adhere to strict measures for proportioning, mixing and placing patch material. They should have measuring equipment on-site to proportion mixes or use pre-measured quantities of patching material.
5. The presence of excess water in the LMC needs to be addressed.
6. These decks should be placed in the “Long-Term Monitoring” study to assess the overlay performance on annually.

## **REFERENCES**

1. Email from Ed Liberati (Hughes Group) to Theodore Hopwood dated 4/9/2015.



Figure 1. WB bridge looking west prior to the onset of the deck repair (August 28, 2014).



Figure 2. EB bridge looking west prior to the onset of deck repair (August 28, 2014).





Figure 3. Deck distress in span 3 of the EB bridge showing failed patches (August 28, 2014).



Figure 4. Deck distress in span 3 of the WB bridge showing failed patches and exposed reinforcing steel (August 28, 2014).





Figure 5. WB bridge showing pier repairs in progress under deck joints (August 28, 2014).



Figure 6. Cracking and efflorescence of the bottom of the WB deck (August 28, 2014).





Figure 7. Cracking and efflorescence of the bottom of the EB deck (August 28, 2014).



Figure 8. WB deck after surface milling showing cut reinforcing steel (September 09, 2014).





Figure 9. Reinforcing steel cut by the milling machine being removed by powered hand saw.



Figure 10. Worker sawing a vertical perimeter of overlay work.





Figure 11. Hydrodemolition unit with operator at the left.



Figure 12. A vacuum truck clean concrete debris from the deck after hydrodemolition.





Figure 13. Inspector using a chain drag to inspect remaining concrete for soundness.



Figure 14. Jackhammering to remove delaminated concrete after hydroblasting. Delaminations were detected by the chain drag method.





Figure 15. Bridge deck after hydroblasting and vacuuming showing patched concrete remaining above the upper mat of reinforcing steel.



Figure 16. Workers placing plastic sheets on prepared deck prior to placement of overlay.





Figure 17. LMC truck and Bidwell paving machine during overlay placement.



Figure 18. A special truck used to mix/discharge the latex modified concrete.





Figure 15. Latex modified concrete being placed with Bidwell paving machine in the back ground.



Figure 20. Worker tying LMC overlay to provide surface texture. Note the wet burlap used to cover the overly during curing.





Figure 21. A “punch through” in WB right lane after hydrodemolition.



Figure 22. The same "punch through" on the WB Bridge after jackhammering.





Figure 23. Workers mixing Duracal® to patch a “punch through.” Note that water is being added to the patching compound by spraying with a hose (no measurement).



Figure 24. Workers applying patching material to fill “punch through”.





Figure 25. Repairing “punch through” by jackhammering to remove loose concrete in EB bridge.



Figure 26. Latex modified concrete being applied to the bridge deck showing excess water.





Figure 27. Repaired WB bridge deck (April 13, 2015).



Figure 28. Repaired EB bridge deck (April 13, 2015).

Appendix A



**CALL NO. 100**

**CONTRACT ID. 142915**

**FRANKLIN COUNTY**

**FED/STATE PROJECT NUMBER IM 0643 (052)**

**DESCRIPTION INTERSTATE 64 (MP 51.516)**

**WORK TYPE BRIDGE DECK RESTORATION & WATERPROOFING**

**PRIMARY COMPLETION DATE 10/15/2014**

**LETTING DATE: July 11, 2014**

Sealed Bids will be received electronically through the Bid Express bidding service until 10:00 AM EASTERN DAYLIGHT TIME July 11, 2014. Bids will be publicly announced at 10:00 AM EASTERN DAYLIGHT TIME.

**NO PLANS ASSOCIATED WITH THIS PROJECT.**

**DBE CERTIFICATION REQUIRED - 0%**

**REQUIRED BID PROPOSAL GUARANTY:** Not less than 5% of the total bid.

## **SCOPE OF WORK**

### **ADMINISTRATIVE DISTRICT - 05**

**CONTRACT ID -  
142915**

**IM 037 0064 B00057**

**L & R COUNTY -**

**FRANKLIN**

**PCN -  
MB03700641401  
037 0064 B00057L &  
R**

INTERSTATE 64 (MP 51.516). BRIDGES OVER CARDWELL  
LANEBRIDGE DECK RESTORATION & WATERPROOFING  
GEOGRAPHIC COORDINATES LATITUDE 38:09:24.21 LONGITUDE 84:55:20.68

#### **COMPLETION DATE(S):**

COMPLETED BY 10/15/2014 APPLIES TO ENTIRE CONTRACT

30 CALENDAR DAYS APPLIES TO 037B00057L

30 CALENDAR DAYS APPLIES TO 037B00057R

## **SPECIAL NOTE FOR BRIDGE RESTORATION AND WATERPROOFING WITH CONCRETE OVERLAYS**

- I. DESCRIPTION.** Perform all work in accordance with the Kentucky Transportation Cabinet, Department of Highway's 2012 Standard Specifications for Road and Bridge Construction and applicable Supplemental Specifications, the Standard Drawings, this Note, and the attached detail drawings. Section references are to the Standard Specifications.

This work consists of the following: (1) Furnish all labor, materials, tools, and equipment; (2) Remove the existing overlay; (3) Remove the partial depth areas by Hydrodemolition; (4) Repair/replace damaged and corroded reinforcing bars; (5) Place new concrete overlay in accordance with Section 606; (6) Complete asphalt approach pavement; (7) Maintain and control traffic; and (8) Any other work specified as part of this contract.

All construction will be in accordance with Section 606 unless otherwise specified.

**II. MATERIALS.**

**A. Latex Concrete.** See Section 606.03.17.

**B. Bituminous Asphalt.** Use CL4 ASPH SURF 0.38A PG76-22.

**III. CONSTRUCTION.**

**A. Remove Existing Overlay.** In addition to Section 606.03.03, totally remove the existing concrete overlay by milling. See Special Note for Use of Hydrodemolition Method.

**B. Partial Depth Slab Repair and Latex Overlay.** After removing the existing overlay, calibrate the hydrodemolition equipment to remove as much unsound material as possible without removing any areas completely through the deck. It is anticipated that no additional partial depth areas will remain after hydrodemolition. In the unlikely event that partial depth areas do remain, the Contractor shall remove them with hand held jackhammers weighing less than 45lbs in accordance with Section 606.02.10 D. Repair/Replace all damaged or severely corroded reinforcing bars prior to partial depth repair operation. The Department will not measure material removal and will consider this work incidental to the bid item "PARTIAL DEPTH PATCHING". Mix and place Latex Modified Concrete Overlay in accordance with Sections 606.03.08 and 606.03.17.

**C. Asphalt Approach Pavement.** Mill each existing asphalt approach for a distance of 50' from the bridge end. Remove the bituminous material uniformly by making an edge key, so as to provide a smooth transition to the finished bridge when a new bituminous overlay of compacted depth of approximately 1½" is added to the approaches. The grinding depth may vary depending of the condition of the existing approach and final elevation of bridge end. Dispose of all removed material away from the site.

**D. Surface Texturing.** Texture the concrete surface of the overlay in accordance with Section 609.03.10.



**IV. MEASUREMENT.** See Section 606 and the following:

**A. Latex Modified Concrete for Overlay.** The Department will measure the quantity in cubic yards using the theoretical volume as follows for each bridge:

$$\begin{array}{lll} 037B00057L & (159' \times 30' \times 2.00'') & = 29.4 \text{ cuyd} \\ 037B00057R & (159' \times 30' \times 2.00'') & = 29.4 \text{ cuyd} \end{array}$$

**B. Latex Modified Concrete for Partial Depth Patching and variable thickness of Overlay.** The Department will measure the quantity in cubic yards by deducting the theoretical volume of bridge deck overlay (LMC) from the total volume (as indicated by the batch quantity tickets) of Concrete required to obtain the finished grade shown on the Plans or established by the Engineer.

**C. Remove Existing Overlay.** The Department will measure the removal of the existing overlay in square yards, which shall include all labor, equipment, and material needed to complete this work.

**D. Steel Reinforcement.** The Department will measure any reinforcing steel necessary for the partial or full depth patch in pounds, which shall include all labor, equipment, and material needed to complete this work.

**E. Asphalt Approach Pavement.** The Department will measure the quantity in square yards, which shall include all labor, equipment, and material needed to complete this work.

**V. PAYMENT.** See Section 606 and the following:

**A. Latex Modified Concrete for Overlay.** The Department will make payment for the Latex Modified Concrete under bid item #08534 "CONCRETE OVERLAY – LATEX" for the theoretical quantity.

**B. Latex Modified Concrete for Partial Depth Patching and variable thickness of Overlay.** The Department will make payment for the Partial Depth Patching under bid item #24094EC "PARTIAL DEPTH PATCHING". Payment will be for the quantity per cubic yard complete in place.

**C. Remove Existing Overlay.** The Department will make payment for the removal of the existing overlay under the bid item #08510 "REM EPOXY BIT FOREIGN OVERLAY". Payment will be for the square yard complete.

**D. Steel Reinforcement.** The Department will make payment for steel reinforcement, if necessary, under bid item #08150 "STEEL REINFORCEMENT". Payment will be at the unit price per pound.

**E. Asphalt Approach Pavement.** The Department will make payment for the completed and accepted quantity of this work under the bid item #03304 "BRIDGE OVERLAY APPROACH PAVEMENT".

## **SPECIAL NOTE FOR REPLACING EXPANSION DAMS AND/OR INSTALLING ARMORED EDGES FOR CONCRETE ON BRIDGES**

**I. DESCRIPTION.** Perform all work in accordance with the Kentucky Transportation Cabinet, Department of Highway's 2012 Standard Specifications for Road and Bridge Construction and applicable Supplemental Specifications, the Standard Drawings, this Note, and the attached detail drawings. Section references are to the Standard Specifications.

This work consists of the following: (1) Furnish all labor, materials, tools, and equipment; (2) Remove existing concrete and expansion device(s) and/or bridge ends; (3) Install new concrete as specified and in accordance with the attached detail drawings; (4) Install new joint seals (where required); (5) Maintain and control traffic; and (6) Any other work specified as part of this contract.

### **II. MATERIALS.**

**A. Steel Reinforcement.** Use Grade 60. See Section 602.

**B. Preformed, Pre-Compressed, Self-Expanding, Sealant System with Silicon Pre-Coated Surface.** Use BEJS by EMSEAL JOINT SYSTEMS or approved equal. Preformed silicone seal shall have cellular polyurethane foam impregnated with hydrophobic 100 percent acrylic, water based emulsion, factory coated with highway-grade, low modulus, fuel resistant silicone.

### **III. EQUIPMENT.**

**A. Hammers.** See Section 606.02.10 B.

**B. Sawing Equipment.** See Section 606.02.10 C.

**C. Hydraulic Impact Equipment.** See Section 606.02.10 D.

### **IV. CONSTRUCTION.**

**A. Remove Existing Materials.** Remove existing Expansion Dam, Bridge End, Armored Edges and specified areas of concrete as shown on the attached sketches. Remove debris and/or expansion joint filler as directed by the Engineer. Clean and leave all existing steel reinforcement encountered in place. Damaged steel reinforcement will be repaired/replaced as directed by the Engineer at no additional cost to the Department.

Dispose of all removed material entirely away from the job site. This work is incidental to the contract unit price for "Expansion Joint Replacement".

**B. Place New Concrete.** After all specified existing materials have been removed, place new LMC concrete in accordance with the detailed drawings. Deepen LMC concrete at bridge ends to a minimum of 3" thick. Place temporary "box outs" for EM SEAL (or approved equal) at intermediate joints. Blast clean all areas of existing concrete and structural steel to come in contact with new concrete until free of all laitance and deleterious substances immediately prior to the placement of the LMC overlay.

**C. Additional Steel Reinforcement.** Furnish for replacement, as directed by the Engineer, 800 linear feet of #4 steel reinforcing bars in 20' lengths. Place these bars in areas deemed by the Engineer to require additional reinforcement. Field cutting and bending is permitted. Ensure that all exposed steel reinforcement is tied in

accordance with Section 602.03.04 prior to pouring the new Class “M” concrete. Deliver unused bars to the Local County Maintenance Barn. Payment will be made in accordance with Section 602.

**D. Preformed, Pre-Compressed, Self-Expanding, Sealant System with Silicon Pre- Coated Surface.** Joint seal shall be installed into manufacturer’s standard field- applied epoxy adhesive. Joint seal is to be installed ½” recessed from the surface such that when the field-applied injection band of silicone is installed between the substrates and the foam-and-silicone-bellows.

**E Shop Plans.** Shop plans will not be required. The Contractor is responsible for obtaining field measurements and supplying properly sized materials to complete the work.

**V. MEASUREMENT.**

**A. Expansion Joint Replacement – 2".** The Department will measure the quantity in linear feet from gutterline to gutterline along the centerline of the joint.

**B. Steel Reinforcement.** See Section 602.

**VI. PAYMENT.**

**A. Expansion Joint Replacement – 2".** Payment at the contract unit price per linear foot is full compensation for removing specified existing materials, concrete, neoprene strip seal or preformed silicone seal and all incidental items necessary to complete the work (except the overlay material) within the specified pay limits as specified by this note and as shown on the attached detail drawings.

**B. Steel Reinforcement.** See Section 602.

**SPECIAL NOTE FOR USE OF HYDRODEMOLITION METHOD**

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**Description**

This work consists of bridge surface deck preparation using Hydrodemolition to provide a uniform depth, highly bondable surface and to remove all variable depth, unsound material. This item also includes the removal and disposal of all concrete and debris, vacuuming, shielding, water control, additional and all other aspects of work necessary to prepare the deck for the placement of the new latex modified concrete overlay.

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**Equipment**



**Hydro-Demolition Equipment.** The Hydrodemolition equipment shall consist of a filtering and pumping unit operating with a self-propelled computerized robot that utilizes a high pressure water jet capable of removing concrete to the depth specified on the plans or as directed by the Engineer and be capable of removing rust and concrete particles from reinforcing steel. The equipment shall provide a rough and bondable surface and remove all unsound concrete during the initial pass. The minimum water usage shall be 43 gal/min operating at 13,000 psi minimum. The pressure and water usage shall be calibrated to remove as much deteriorated concrete without removing any areas of the deck completely, to the satisfaction of the engineer.

**Vacuum Cleanup Equipment.** The vacuum cleanup equipment shall be equipped with fugitive dust control devices and be capable of removing wet debris and water all in the same pass. Provide equipment capable of washing the deck with pressurized water prior to the vacuum operation to dislodge all debris and slurry from the deck surface.

**Hand Held Blast Cleaning Equipment.** Hand held blast shall be either sand or water as necessary to expose fine and coarse aggregates; thoroughly clean all exposed reinforcing steel; and remove any unsound concrete or laitance layers from the proposed concrete overlay surface. If sand blasting equipment is utilized, the equipment shall have oil traps. If water blasting equipment is utilized, the equipment must be capable of delivering a minimum of 5,000 psi.

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## Construction Methods

**General:** Perform Hydrodemolition surface preparation over the entire top surface of the reinforced concrete bridge deck to provide a rough and bondable surface and to remove all unsound concrete during the initial Hydrodemolition surface preparation pass.

**Description:** This work shall consist of furnishing the necessary labor, materials and equipment to completely remove the top surface of the Portland cement concrete bridge deck surface in accordance with these Specifications and in reasonably close conformity with the grades, thickness, or sections shown on the Plans or as directed by the Engineer. This work shall include the removal of patches other than sound Portland cement concrete and all loose and unsound concrete by Hydrodemolition; preparation of the sound existing concrete surface; removal, forming and concrete for full depth repairs; blast cleaning or high pressure water cleaning the existing deck prior to placement of the modified concrete overlay; and all other operations necessary to complete this work according to these specifications and to the satisfaction of the Engineer.

**General:** The total surface area of the reinforced concrete bridge deck shall be completely prepared by Hydrodemolition as necessary to provide a highly roughened and bondable surface prior to placement of the proposed bridge deck overlay while removing any deteriorated and unsound concrete in the initial pass. Unsound concrete is defined as existing bridge deck concrete that is deteriorated, spalled, or determined by the engineer to be unsound.

With the use of Hydrodemolition surface preparation, the requirement to provide a minimum 1/4" clearance around all reinforcing bars that are more than 1/2" diameter exposed is waived, providing that the existing concrete is sound. The amount of steel exposed shall be kept to a minimum.

Calibration shall be required on each structure; each time Hydrodemolition is performed and as required to achieve the results specified by the plan.

**Debris and Fluid Containment:** Prior to commencement of the Hydrodemolition operation, the Contractor shall submit a plan for approval to the engineer for control and filtering of all water discharged during operation. The Contractor, at a minimum, shall block all drains on the deck and install aggregate dams every 150 feet; 6 inches high by 1 foot wide minimum, to strain runoff. The deck shall be used as a settlement basin within itself unless an alternate method of water control, satisfactory to the Engineer and meeting the environmental requirements of any associated Regulatory Agency, is required.

The Contractor shall provide shielding, as necessary, to insure containment of all dislodged concrete within the removal area in order to protect the public from flying debris both on and under the work site.

Cleaning shall be performed with a vacuum system capable of removing wet debris and water all in the same pass. The vacuum equipment shall be capable of washing the deck with pressurized water prior to the vacuum operation to dislodge all debris and slurry from the deck surface. Cleaning shall be done in a timely manner, before debris and water is allowed to dry on the deck surface.

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## Method of Measurement

Hydrodemolition will be measured in square yards.

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## Basis of Payment

Hydrodemolition will be paid by the bid item #8550 "HYDRODEMOLITION"

**SPECIAL NOTE FOR CONTRACT COMPLETION DATE AND LIQUIDATED DAMAGES ON BRIDGE REPAIR CONTRACTS**

- I. COMPLETION DATE.** The Contractor has the option of selecting the starting date for this Contract. Once selected, notify the Department in writing of the date selected at least two weeks prior to beginning work. All work is to be completed by October 15, 2014. All work is to be completed in 12 hour lane closures as specified in the Traffic Control Special note.
- II. LIQUIDATED DAMAGES.** Liquidated damages will be assessed the Contractor in accordance with the Transportation Cabinet, Department of Highway's 2012 Standard Specifications for Road and Bridge Construction, Section 108.09, when the allotted October 15, 2014 date is exceeded.

Additionally, liquidated damages of \$5,000 per hour will be assessed the Contractor when the allotted number of hours is exceeded.

Contrary to the Standard Specifications, liquidated damages will be assessed the Contractor during the months of December, January, February and March when the contract time has expired on any individual bridge or bridges. Contract time will be charged during these months.

All construction must be completed in accordance with the weather limitations specified in Section 606 and/or Section 601 as applicable. No extension of Contract time will be granted due to inclement weather or temperature limitations that occur due to starting work on the Contract or a structure late in the construction season.

**SPECIAL NOTE FOR TRAFFIC CONTROL ON BRIDGE REPAIR**

**CONTRACTS I. TRAFFIC CONTROL GENERAL**

Except as provided herein, traffic shall be maintained in accordance with the 2012 Standard Specifications, Section 112. Except for the roadway and traffic control bid items listed, all items of work necessary to maintain and control traffic will be paid at the lump sum bid price to "Maintain and Control Traffic".

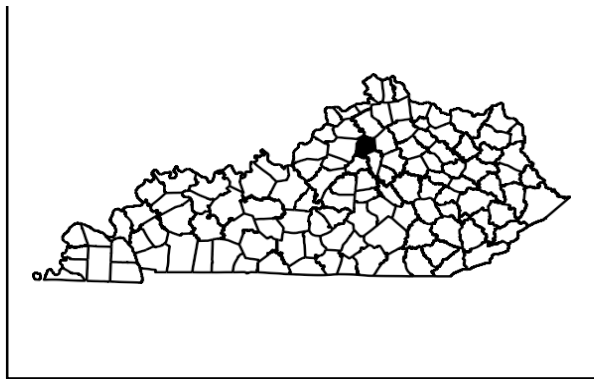
Contrary to Section 106.01, traffic control devices used on this project may be new or used in new condition, at the beginning of the work and maintained in like new condition until completion of the work.

## **II. TRAFFIC COORDINATOR**

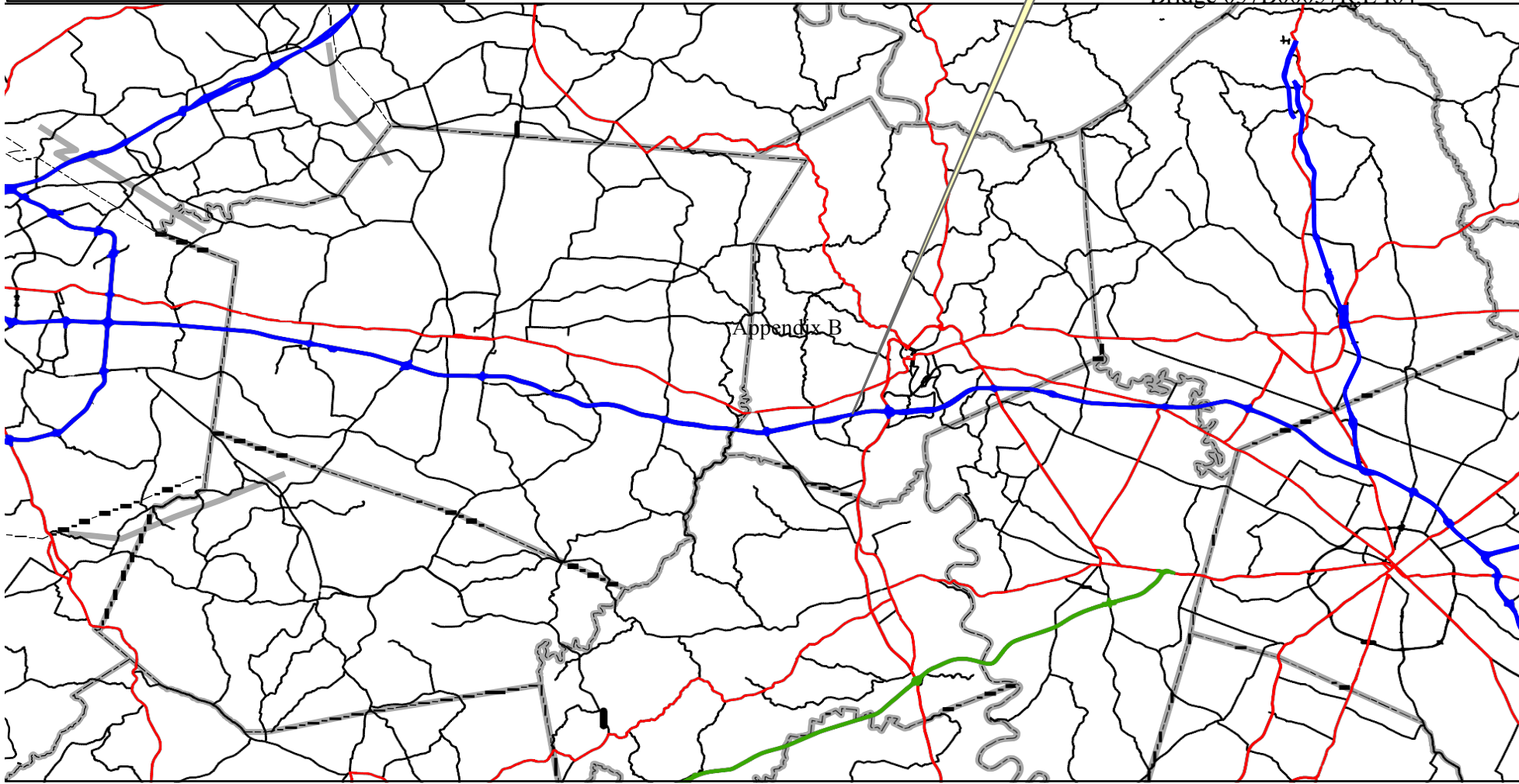
Furnish a Traffic Coordinator as per Section 112. The Traffic Coordinator shall inspect the project maintenance of traffic, at least three times daily, or as directed by the Engineer, during the Contractor's operations and at any time a lane closure is in place. The personnel shall have access on the project to a radio or telephone to be used in case of emergencies or accidents.

The Traffic Coordinator shall report all incidents throughout the work zone to the Engineer on the project. The Contractor shall furnish the name and telephone number where the Traffic Coordinator can be contacted at all times.





Bridge 037B00057R.L I64



Date Run : 7/11/14 , 11:11:33 AM GMT-04:00

Contid: 14-2915

District: 05

Date Let: 07-11-14

Contid: 14-2915      SYP: 05-00520.00

Length: 0 Miles

Time: 10/15/2014

BRIDGE DECK RESTORATION &amp; WATERPROOFING INTERSTATE 64 (MP 51.516)

Number of Bidders 5

2	02812	DELONG CONCRETE LLC	835,489.00
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4	02185	AMERICAN CONTRACTING & SERVICES INC	923.620.82
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4	02185	AMERICAN CONTRACTING & SERVICES INC	923.620.82
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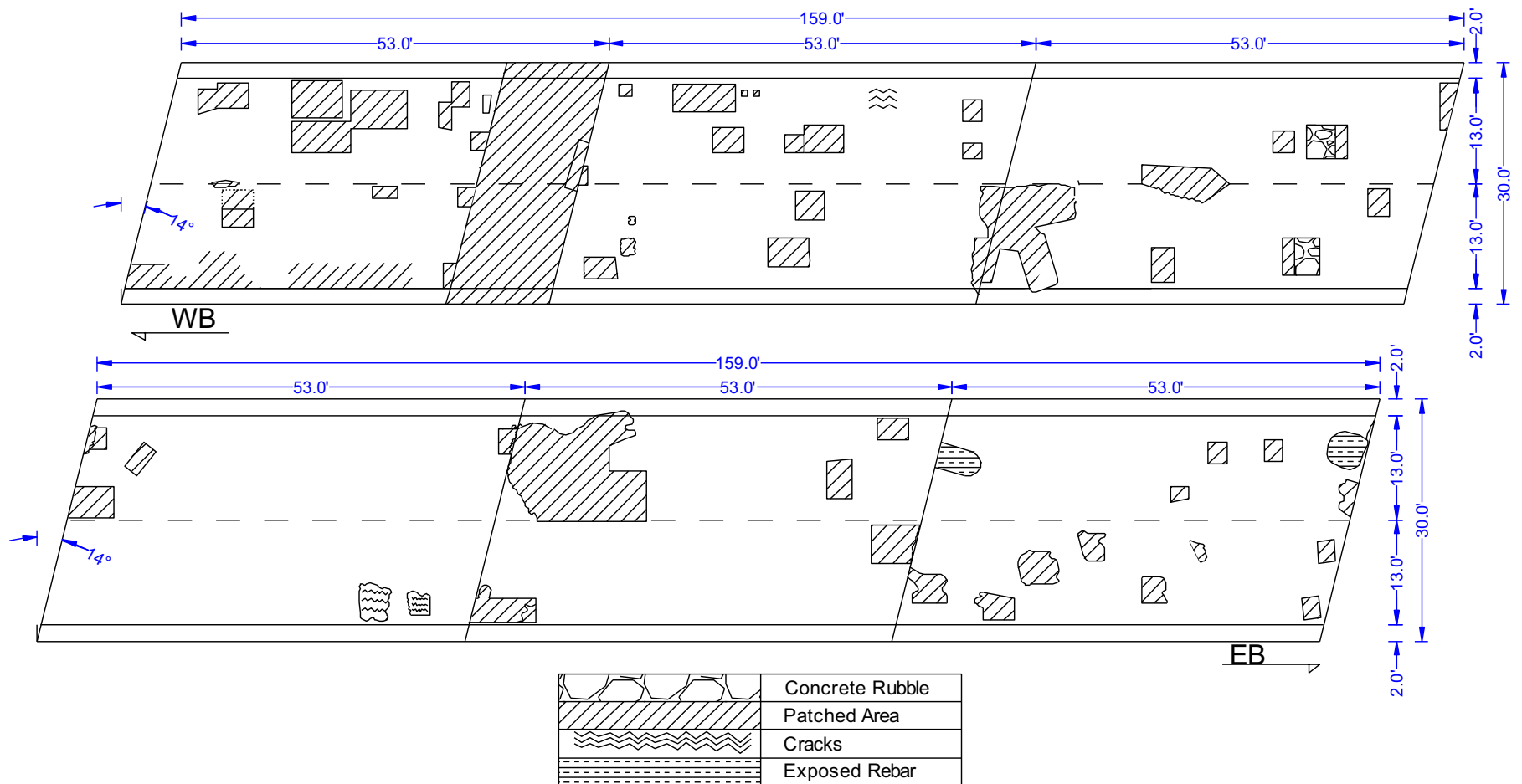
5	00131	M & M SERVICES CO INC	1,082,629.46
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891,534.99

LOW BIDDER is -11.83% from ENGINEERS ESTIMATE

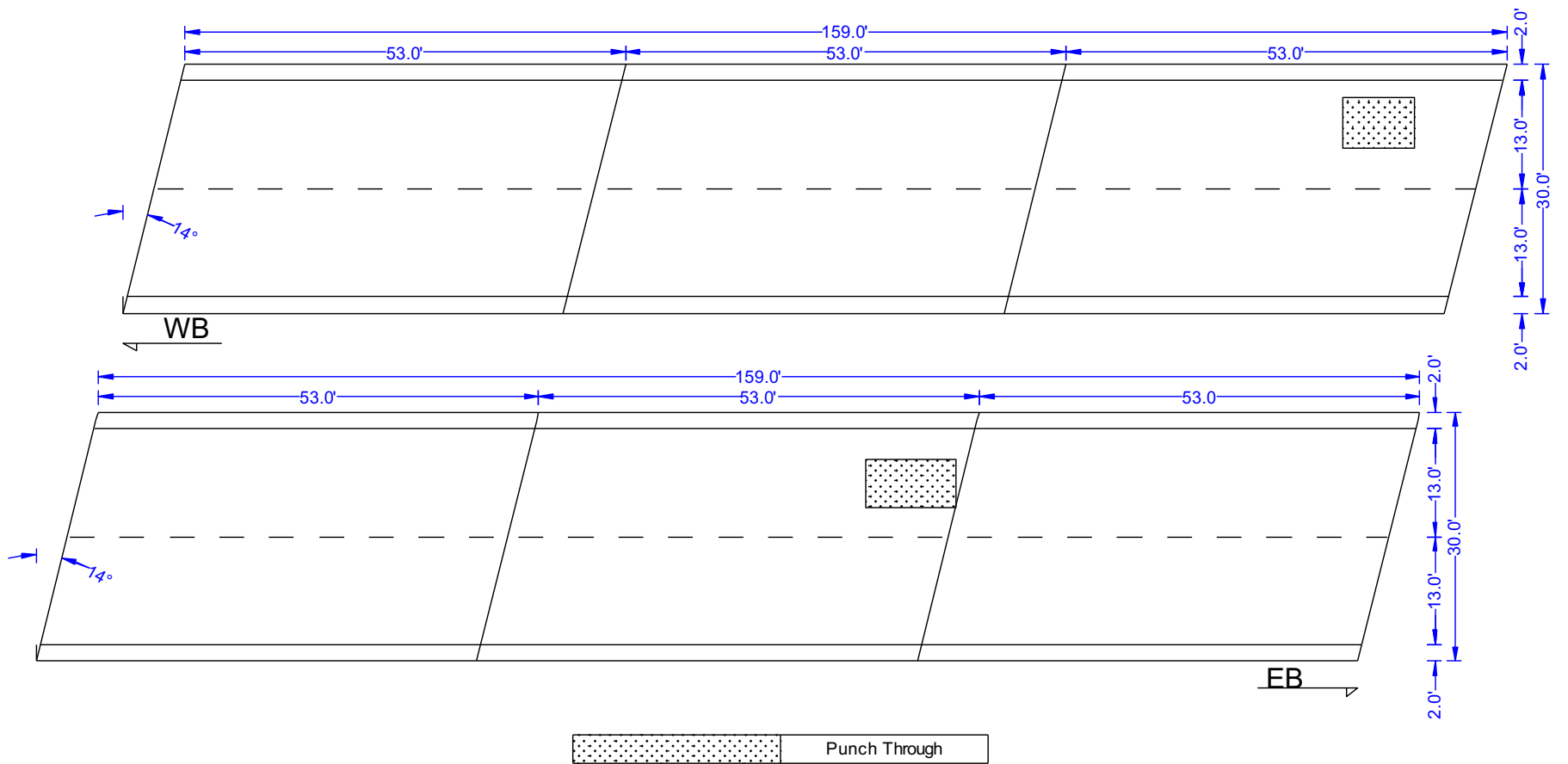
Apparent Low Bidder Low > HALL CONTRACTING OF KENTUCKY INC

Prop Line	Item Description	Quantity	Unit	Bidder1	Bidder2	Bidder3	Bidder4	Bidder5	Bidder6
0010	TEMPORARY SIGNS	298.000	SQFT	5.00	10.00	5.00	6.00	15.00	
0020	MAINTAIN & CONTROL TRAFFIC	1.000	LS	85,000.00	10,000.00	10,000.00	25,000.00	30,000.00	
0030	MAINTAIN & CONTROL TRAFFIC	1.000	LS	85,000.00	10,000.00	10,000.00	25,000.00	30,000.00	
0040	LANE CLOSURE	4.000	EACH	1,500.00	10,000.00	2,000.00	2,000.00	12,000.00	
0050	TRUCK MOUNTED ATTENUATOR	2.000	EACH	1,500.00	2,500.00	3,000.00	3,000.00	2,200.00	
0060	PORTABLE CHANGEABLE MESSAGE SIGN	2.000	EACH	500.00	500.00	1,500.00	1,000.00	2,400.00	
0070	ARROW PANEL	2.000	EACH	300.00	500.00	500.00	1,000.00	800.00	
0080	EXPAN JOINT REPLACE 2 IN	123.600	LF	200.00	150.00	100.00	160.00	480.00	
0090	BRIDGE OVERLAY APPROACH PAVEMENT	666.000	SQYD	100.00	87.00	90.00	86.84	95.00	
0100	PAVE STRIPING-PERM PAINT-6 IN	1,166.000	LF	1.50	1.00	2.00	2.00	5.00	
0110	PAVE STRIPING-TEMP REM TAPE-W	2,180.000	LF	1.60	1.00	.01	1.70	2.25	
0120	PAVE STRIPING-TEMP REM TAPE-Y	2,180.000	LF	1.60	1.00	.01	1.70	2.25	
0130	STEEL REINFORCEMENT	534.000	LB	1.50	1.00	2.00	1.70	3.00	
0140	REM EPOXY BIT FOREIGN OVERLAY	1,060.000	SQYD	27.00	50.00	35.00	60.00	34.00	
0150	CONCRETE OVERLAY-LATEX	58.800	CUYD	2,500.00	3,000.00	2,650.00	2,600.00	2,300.00	
0160	BLAST CLEANING	1,060.000	SQYD	2.00	10.00	10.00	6.00	15.00	
0170	HYDRODEMOLITION	1,060.000	SQYD	90.00	100.00	100.00	85.00	35.00	
0180	CONCRETE PATCHING REPAIR	2,376.000	SQFT	70.00	125.00	165.00	165.00	195.00	
0190	PARTIAL DEPTH PATCHING	55.200	CUYD	950.00	500.00	1,100.00	850.00	2,100.00	
0200	DEMOBILIZATION	1.000	LS	13,000.00	12,347.00	13,162.71	13,669.58	15,999.46	
Total Bid				787,836.00	835,469.00	890,676.31	923,620.82	1,082,629.46	





Plan view of bridge decks showing major areas of visible distress prior to the onset of the overlay work.



Plan view of the twin bridges showing “punch through” locations